APPENDIX E
SPECIAL CASE LOW LEVEL WASTE

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E. SPECIAL CASE LOW-LEVEL WASTE

Naval spent nuclear fuel assemblies are disassembled at the Idaho National Engineering Laboratory (INEL) so that the fuel bearing areas can be inspected as part of the Navy's program for improvement of the fuel assemblies. With the disassembly of the assemblies, spent fuel bearing sections and non fuel-bearing low-level radioactive waste are created. The non fuel-bearing low-level radioactive waste can be further categorized into one of several classes. U.S. Nuclear Regulatory Commission regulations in 10 CFR Part 61 identify three classes of low-level waste, namely classes A, B, and C. Disposal of low-level radioactive waste in Classes A, B, or C is accomplished by land burial pursuant to DOE and Nuclear Regulatory Commission requirements.

There are also wastes with concentrations of certain short- and long-lived isotopes which are greater than those specified for Class C. These naval low-level wastes are classified as a type of special case waste. (Such wastes are classified as Greater Than Class C wastes when they are generated by the commercial sector.) Disposal of special case waste requires more stringent measures, including possibly burial in a geologic repository. This appendix covers the possible disposal of non fuel-bearing low-level radioactive waste that is classified as a special case waste by using the same dry storage and container options chosen for naval spent nuclear fuel.

E.1 Background

All naval fuel assemblies have metal structures (which contain no fuel) above and below the fuel region to facilitate coolant flow and maintain proper support and spacing within the reactor. These upper and lower non-fuel bearing structures must be removed at the Expended Core Facility to provide access to the fuel-bearing sections to permit inspection of the assembly. Removal of these structures also reduces the storage space ultimately required for spent fuel by approximately 50%.

The upper and lower non-fuel bearing structures removed during the preparation of fuel assemblies are evaluated using the waste classification criteria established by federal regulations in 10 CFR Part 61. These non-fuel bearing structures do not contain any fuel, or fission products from fuel, and therefore are not "spent nuclear fuel." They also do not contain transuranic elements or fission products and, thus, are not "trans waste" or "high-level waste", respectively. Therefore, the nature of the radioactivity in these non-fuel bearing structures (sometimes called "end boxes") causes them to be classified as low-level waste. This low-level waste is further classified based upon disposal requirements.

After removal from the spent fuel, those non-fuel bearing structures meeting the requirements for near-surface disposal (Classes A, B, or C) are shipped to the INEL Radioactive Waste Management Complex using a shielded cask, as identified in the Programmatic SNF and INEL EIS (DOE 1995). There the structures are disposed of in accordance with the Department of Energy (DOE) requirements for the appropriate class of low-level radioactive waste.

A portion of the non-fuel bearing structures may contain concentrations of certain short- and long-lived isotopes which are greater than those specified for Class C. Such wastes are regulated as not generally suitable for near-surface disposal. These wastes are classified as special case low-level radioactive waste.

Currently, about 35 cubic meters of special case low-level waste in material removed from above and below the fuel region of naval spent nuclear fuel assemblies over the years is being stored at the Naval Reactors Facility pending availability of an appropriate disposal facility, possibly licensed by the Nuclear Regulatory Commission, or a centralized interim storage site. In addition to the special case low-level waste already in storage, it is estimated that about 460 cubic meters special case waste will be removed from naval spent fuel assemblies to be shipped to the Expended Core Facility during the period from 1996 through 2035.

E.2 Characteristics of Special Case Waste

The non-fuel bearing metal structures removed from the upper and lower ends of naval spent nuclear fuel assemblies are principally made either of Inconel or of the same alloy of zirconium used for fuel cladding. They have been exposed to the same operating conditions as the fuel since they were physically attached to the fuel assemblies. However, these structures contain no nuclear fuel or fission products. They are radioactive because some neutrons from the reactions in the core have activated the atoms of the metal in the end structures. They are also radioactive because some of the radioactive corrosion products from the reactor have been deposited on their metal surfaces.

When each assembly is received at the Expended Core Facility at INEL, it is in exactly the same condition as at the time it was removed from a naval reactor. The top and bottom ends of each assembly have a mechanical support and extensions of fuel elements which do not contain any nuclear fuel. These ends are needed to allow for joining of individual elements into an assembly during manufacture, to direct the water flow into and out of the fuel region during reactor operation, and to support the assembly mechanically. These structures are often relatively bulky and must be removed before naval spent nuclear fuel can be examined because they obstruct visual access to the interior of the fuel assembly. Therefore, the extensions are cut off the fuel assembly at the Expended Core Facility as part of the preparations for examination of the assembly.

The end structures are made of solid metal. They are less radioactive than naval spent nuclear fuel assemblies and generate very little heat from radioactive decay. No liquid would be included in the storage or shipping containers used for this waste. The end structures are not hazardous waste under the Resource Conservation and Recovery Act because they contain no hazardous materials as designated under that Act. They are not explosive, reactive, corrosive, flammable, toxic, or combustible.

E.3 Dry Storage Options

This EIS describes several alternatives for the storage of naval spent nuclear fuel until such time as shipment to a permanent disposal repository or a centralized interim storage site can be made. This Appendix describes several alternatives for storage of special case waste until shipment to a permanent disposal repository or a centralized interim storage site. It is assumed for the purpose of this EIS that the special case low-level waste could be stored in the same alternative locations selected for storage of naval spent nuclear fuel using the same alternative storage systems. The number of special case waste containers was developed considering the internal cavity lengths and diameters associated with the various alternative container types. The number of container shipments that would be needed for special case waste is identified in Table E.1, and is seen to be about 15-20% of the number required for naval spent nuclear fuel. Therefore, the impacts from special case waste represent a small incremental increase in associated risks. The incremental increase in risk would be less than 20% because this waste contains no fission products and thus contains less radioactive material.

TABLE E.1 Estimated Number of Container Shipments Required for Special Case Low-Level Radioactive Waste Removed from Naval Spent Nuclear Fuel Assemblies

Alternative	Estimated Number of Container Shipments
Multi-Purpose Canister	60
No-Action	55
Current Technology/Rail	55
Transportable Storage Cask	45
Dual-Purpose Canister	45
Small Multi-Purpose Canister	85

In the Programmatic SNF and INEL EIS (DOE 1995; Volume 2, Part B, C.4.7.1), the DOE described a project for Greater Than Class C waste dedicated storage at the Idaho Chemical Processing Plant. The objective of that proposed project would be to provide for DOE receipt and storage of Greater Than Class C low-level waste sealed radiation sources from the commercial sector. Other Greater Than Class C low-level waste would be received on an as-needed basis. In May 1989, the Nuclear Regulatory Commission promulgated a rule that requires disposal of commercially generated low-level waste with concentrations of radioactivity Greater Than Class C waste in a deep geologic repository, unless disposal elsewhere is approved by the Nuclear Regulatory Commission. Although the DOE has identified that the project is designed to handle Greater Than Class C low-level waste from commercial sources, another alternative is to consider the possibility of using that facility for storage of naval program special case low-level waste until shipment to a centralized interim storage site or a repository for permanent disposal.

DOE has assigned the management responsibility for Greater Than Class C low-level waste to the INEL. The design basis for the Greater Than Class C waste Storage Facility would be an outdoor above-grade concrete lay-down pad on which appropriately shielded casks would be placed. For storage, the project would involve the expansion of an existing concrete pad, or the construction of a new concrete pad, and the procurement of numerous concrete storage casks. Existing grounds and facilities at the INEL could be modified and used for waste receiving and handling operations as described in the Programmatic SNF and INEL EIS (DOE 1995; Volume 2, Part B, C.4.7.1-4).

E.4 Candidate Containers for Special Case Waste

It is currently planned that the naval spent nuclear fuel assembly end structures which are classified as special case waste would be placed into the same type of container system selected for dry storage and shipment of naval spent nuclear fuel. The same type of containers would be used to simplify operations of INEL and repository facilities, and because current policy requires that spent nuclear fuel be placed into a geologic repository and special case waste may also be authorized for disposal in a geologic repository.

Placing the special case waste from the Expended Core Facility into containers designed to provide shielding for spent nuclear fuel, which is much more radioactive, means that the shielding in the container walls would reduce the radiation outside the containers to levels lower than those obtained with spent fuel. The containers used for storage and shipment of naval spent nuclear fuel would provide adequate structural strength even when loaded to full capacity with end structures removed from naval spent nuclear fuel. Therefore, the containers selected for dry storage and shipment of naval spent nuclear fuel would be adequate to provide protection for the environment and the public from the naval special case low-level radioactive waste.

E.5 Manufacturing Impacts of Containers for Special Case Waste

The impacts of manufacturing enough containers for the special case waste from naval spent nuclear fuel have been included in the manufacturing impacts presented in Chapter 4 and represent about 15-20% more of the same containers used for naval spent nuclear fuel that would be needed. This 15-20% increment is based on the relative volume of naval spent nuclear fuel to be shipped to a repository during the period considered in this EIS and the amount of special case waste existing in the same period. This percentage would be about the same for all alternative container systems considered. The internal structure of the containers for special case waste would be more simple than that for spent nuclear fuel. The containers for special case waste would need neither provisions to prevent nuclear chain reactions nor heat generated by radioactive decay.

E.6 Environmental Impacts During Dry Storage of Special Case Waste

The non-fuel bearing metal structures removed from the ends of naval spent nuclear fuel assemblies generate so little heat from radioactive decay that they do not need to be stored in water pools after removal from the assemblies. Since the space in the Expended Core Facility is more appropriately utilized for naval spent nuclear fuel examination operations and the cooling provided by the water is not needed, it would be desirable to move the end pieces to dry storage as soon as practical. The materials in the end structures from naval spent nuclear fuel can be stored in dry containers or in water pools indefinitely without deterioration.

The storage containers for this special case waste could be placed at the same storage location used for the naval spent nuclear fuel without any problems or difficulties. Using the same storage location would simplify operations associated with storage and preparation for shipment to a repository and avoid duplication of monitoring operations and heavy equipment.

Assuming the same distances from an array of containers to the boundary of the storage location, the radiation levels at the periphery of a storage location used for naval spent nuclear fuel would be increased by less than 15-20% if the special case waste were included because of the lower radiation levels contributed by each container of special case waste and because the containers near the edge of the array of storage containers would act as shielding for containers toward the center. Workers beyond the boundaries of the storage array would be limited to less than 100 millirem per year in accordance with federal regulations regardless of whether the special case waste was included or not. The radiation levels to which the general public might be exposed would be essentially unchanged because of the large distances from the storage site to the boundaries of the INEL and to the nearest points of unrestricted access.

Accidents involving storage containers filled with special case waste from naval spent nuclear fuel examinations would not be as severe as those for naval spent nuclear fuel because there would be less total radioactive material in a container of end structures and because there would be no fission products, which are generally more readily dispersed in air than are activation products bound up in solid metal.

Table E.2 tabulates the isotopes and the activities that could be released in an accident involving naval special case waste under dry storage conditions. Conditions used in developing the source term, are as follows:

- The amount of corrosion products is based on best estimate values.
- One percent of the original corrosion products might be released to the atmosphere due to thermal air currents.
- No filtration by HEPA filters is assumed.

TABLE E.2 Radionuclide Amounts Potentially Released for a Wind-Driven Projectile Impact Accident Involving SCW in Dry Storage[a]

	Alternative/Curies			
Radionuclide	NAA or CTR	MPC	TSC or DPC	SmMPC
Cobalt-60	6.7×10^{-2}	6.1×10^{-2}	7.8×10^{-2}	4.2×10^{-2}
Iron-55	1.2×10^{-1}	1.1×10^{-1}	1.4×10^{-1}	7.7×10^{-2}
Cobalt-58	2.5×10^{-2}	2.3×10^{-2}	3.0×10^{-2}	1.6×10^{-2}
Manganese-54	4.2×10^{-3}	3.9×10^{-3}	4.9×10^{-3}	2.6×10^{-3}
Nickel-63	2.2×10^{-2}	2.0×10^{-2}	2.6×10^{-2}	1.4×10^{-2}

[a] Notation: SCW = special case waste; NAA = No-Action; CTR = Current Technology/Rail; MPC = Multi-Purpose Canister; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister

Compared to the radionuclide amounts tabulated on page A-36 of Appendix A, it is apparent that the consequences from an accident involving a container of naval spent nuclear fuel would be greater than those for a similar accident involving a container of naval special case low-level waste. Therefore, the accidents analyzed in Appendix A of this EIS for naval spent nuclear fuel in storage locations at INEL would produce consequences greater than could occur for the special case waste. Those consequences would not be exceeded by a similar accident for special case waste in storage.

E.7 Shipment of Special Case Waste to a Disposal Site or Centralized Interim Storage Site

Just as the use of the same container for naval spent nuclear fuel and special case waste from naval spent nuclear fuel examinations would simplify operations and procurement for storage systems, it would make operations and equipment needs for shipments to a geologic repository or a centralized interim storage site less complicated if such a site were authorized to receive special case waste. The requirements for shipment of naval spent nuclear fuel are as stringent or more stringent than those for the shipment of special case waste, so containers designed and certified for the shipment of naval spent nuclear fuel would be adequate for the naval special case waste as well.

The containers designed for shipment of naval spent nuclear fuel could also be used for shipment of special case waste from the Expended Core Facility because the radiation levels on the exterior of the containers for special case waste would be lower than those used for naval spent nuclear fuel. The same radiation levels have been used for shipping containers carrying both cargos in the analyses in this EIS to provide estimated effects that would not be exceeded. There would be less need for removal of heat generated by radioactive decay in the special case waste shipping containers than in containers loaded with naval spent nuclear fuel and there would be no concern with accidental uncontrolled nuclear chain reactions in containers of special case waste because they would contain no nuclear fuel.

Table E.3 tabulates the isotopes and the activities that could be released in a transportation accident involving a worst-case shipment of naval special case waste. Conditions used in developing the source term are as follows:

- To reflect the most severe accident conditions, 100% of the available corrosion products are assumed to be released to the interior of the container.
- It is assumed that damage to the shipping container might be great enough to allow 10% of the corrosion products to escape to the environment through the damaged area. The remainder would be trapped inside the container.

TABLE E.3 Radionuclide Amounts Potentially Released in an Accident Involving SCW During Transportation[a]

	Alternative/Curies			
Radionuclide	NAA or CTR	MPC	TSC or DPC	SmMPC
Cobalt-60	3.8×10^{-1}	3.5×10^{-1}	4.4×10^{-1}	2.3×10^{-1}
Iron-55	4.1×10^{-1}	3.8×10^{-1}	4.8×10^{-1}	2.6×10^{-1}
Cobalt-58	5.2×10^{-8}	4.8×10^{-8}	6.1×10^{-8}	3.2×10^{-8}
Manganese-54	1.3×10^{-3}	1.2×10^{-3}	1.5×10^{-3}	7.9×10^{-4}
Nickel-63	2.1×10^{-1}	1.9×10^{-1}	2.5×10^{-1}	1.3×10^{-1}
Strontium-90[b]	2.6×10^{-4}	2.4×10^{-4}	3.0×10^{-4}	1.6×10^{-4}

[a] Notation: SCW = special case waste; NAA = No-Action; CTR = Current Technology/Rail; MPC = Multi-Purpose Canister; TSC = Transportable Storage Cask; DPC = Dual-Purpose Canister; SmMPC = Small Multi-Purpose Canister

[b] Strontium-90 is a fission product from trace elements in structural material that has plated out onto the end boxes, along with activated corrosion products.

As in the case of accidents involving the storage of special case waste from the Expended Core Facility, accidents associated with shipping such waste to a geologic repository would have less impact than accidents involving naval spent nuclear fuel. As previously discussed, this is because the special case waste contains no fission products, and each container therefore contains less overall radioactive material than a container of naval spent nuclear fuel. The radiological doses that are shown in Appendix B and in Table 7.4 of this EIS have been calculated using the conservative assumption that a container of special case waste involved in an accident would release the same amount of radioactive material as a container of naval spent nuclear fuel involved in an accident. Therefore, the accidents analyzed in Appendix B of this EIS have been used to provide estimates of consequences which are greater than those that could occur for shipment of special case waste from the examination of naval spent nuclear fuel.